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Spin Hall Conductivity and Spin Chern Number for Dirac Systems ELIF YUNT, OMER FARUK DAYI, Istanbul Tech Univ — A semiclassical differential form formalism of the spin Hall effect for Dirac systems is presented. In this formalism, space coordinates and momenta are usual dynamical variables, whereas spin is not a dynamical degree of freedom. Spin depicts itself in the matrix-valuedness of equations of motion. We demonstrate that the main contribution to the spin Hall conductivity is given by the spin Chern number whether the spin is conserved or not at the quantum level. We illustrated the formulation within the Kane-Mele model of graphene in the absence and in the presence of the Rashba spin-orbit coupling term. Kane-Mele Model of graphene, which incorporates intrinsic spin-orbit interaction, constitutes the first example of a two dimensional topological insulator. We established the anomalous Hall conductivity as well as the spin Hall conductivity from the term linear in the electric field and the Berry curvature in the the anamolous velocity term. In a basis where the component of spin under consideration is diagonal this term is diagonal. We argue that this semiclassical procedure of calculating the spin Hall conductivity can be generalized to any dimension.

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